

APPARATUS AND METHODS FOR OFF-PUMP CARDIAC SURGERY

FIELD OF THE INVENTION

The present invention relates generally to surgical instruments, and more specifically to retractors and instruments for performing heart surgery.

BACKGROUND OF THE INVENTION

In conventional heart surgery, an incision is made in the chest, either through the sternum (a median sternotomy) or between the ribs (a thoracotomy) in order to gain access into the chest cavity. A retractor is placed in the chest incision which allows the chest bones and tissue to be spread apart to create a wide opening. Surgical instruments are then placed through this opening to perform surgery on the heart.

One of the most common types of heart surgery is coronary artery bypass grafting, or CABG. In CABG, a blockage in one or more coronary arteries is bypassed by connecting a graft vessel to the coronary artery downstream of the blockage. The technique of connecting the graft vessel to the coronary artery is known as anastomosis. The graft vessel may be a mammary artery dissected from the chest wall, wherein the upstream end of the artery is left intact and the downstream end is attached to the coronary artery. Alternatively, the graft vessel may be a section of artery or vein from elsewhere in the patient's body, or an artificial vascular graft, wherein the upstream end of the graft is attached to an artery such as the aorta, and the downstream end is connected to the coronary artery. In this way, multiple coronary artery blockages at various locations on the front, side or back of the heart may be bypassed using multiple graft vessels.

Conventionally, CABG is performed with the heart stopped, while the patient is supported on cardiopulmonary bypass, whereby the patient's blood is circulated by means of an extracorporeal pump and oxygenation system. In certain cases, however, CABG may be performed with the heart beating in a technique known as "beating heart" or "off-pump" coronary artery bypass (OPCAB), allowing cardiopulmonary bypass to be avoided.. In OPCAB, the surface of the heart near the anastomosis site on the coronary artery is stabilized using a specialized instrument while the heart continues to beat. This local stabilization keeps the anastomosis site as motionless as possible while the graft vessel is connected to the coronary artery. The coronary

artery is temporarily occluded or a temporary shunt is inserted into the coronary artery during the anastomosis to keep the site free of blood.

The basic functions required in an OPCAB procedure include sternal or rib retraction, heart manipulation, heart stabilization, pericardial retraction, coronary traction and hemostasis. Sternal retraction involves prying apart the opposing halves of the divided sternum to open the chest cavity. Heart manipulation entails moving, turning or lifting the heart in order to access coronary arteries on the front, back or sides of the heart. Heart stabilization is the process of stabilizing the surface of the beating heart near the anastomosis site to allow the anastomosis to be performed.

Pericardial retraction is used to pull the incised pericardium out of the way for better access to the heart. Coronary retraction involves placing a suture or silastic under the coronary arteries near the anastomosis site and exerting traction on the suture or silastic so as to better expose the coronary artery. This traction may also serve to occlude the coronary artery above and below the anastomosis site to provide hemostasis. In some cases, a temporary shunt may be inserted through an arteriotomy in the coronary artery to allow blood to flow past the anastomosis site during the procedure.

While surgeons have performed OPCAB surgery for a number of years using conventional instruments, in recent years, specially-designed instruments have been introduced to facilitate OPCAB. However, such instruments have suffered from certain drawbacks. For example, commercially available OPCAB systems frequently do not allow the surgeon a sufficient range of positions and degrees of freedom in positioning the stabilizing instrument and other devices utilized in the procedure. In addition, some commercially available OPCAB systems are disposable in major part or in their entirety, thus requiring the disposal of one system and the purchase of a new system each time a procedure is performed. On the other hand, entirely reusable systems frequently fail to provide the means to perform all of the required OPCAB functions described above, or are inferior in their performance of such functions.

What is needed therefore, is a system for performing OPCAB which facilitates sternal retraction, heart stabilization, pericardial retraction, coronary traction, and heart manipulation while the heart is beating. The system should provide maximum flexibility and degrees of freedom for positioning the heart stabilizing instrument and other components of the system. The system should have a minimum number of

disposable components, and should be simple to use and cost-effective. The system should have the flexibility for use in either a sternotomy or a thoracotomy, and should be useful in both OPCAB surgery as well as other forms of cardiac surgery, with and without the heart beating.

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SUMMARY OF THE INVENTION

The present invention provides systems for performing OPCAB and other types of cardiac surgery which overcome many of the drawbacks of current devices. The system provides additional degrees of freedom and ranges of position than currently available devices. The invention enables sternal or rib retraction, pericardial retraction, heart manipulation, coronary traction, and heart stabilization using a single integrated system. While providing such functionality, the systems of the invention preferably utilize an entirely reusable retraction platform, thereby eliminating the waste and cost associated with some current systems.

In a first embodiment, the invention provides an apparatus for performing surgery on a heart of a patient comprising a first arm, a second arm and an actuator, the actuator moving the first arm relative to the second arm. The apparatus further includes a first blade on the first arm and a second blade on the second arm, the first and second blades having first and second surfaces facing away from each other, the first and second surfaces being adapted to atraumatically engage tissue or bone for the retraction thereof. The apparatus also includes a stabilizer adapted to be mounted to one of the first and second arms and having a foot, the foot being configured to atraumatically engage the surface of the heart. In a preferred embodiment, the first and second blades are removably coupled to the first and second arms whereby the first and second blades may be removed and replaced with alternate blades. The ability to quickly and easily remove and replace blades allows the surgeon to select the ideal blade for the particular patient and procedure being performed. The apparatus of the invention thus allows blades of various size, shape, and material to be interchanged. Preferably, the arms and blades are a biocompatible metal so as to be resterilizable and reusable, but alternatively either or both could be made of plastic or other suitable material and could be individually packaged and sterilized for single use.